Claims

1. Semiconductor base structure for molecular electronics and molecular electronics-based biosensor applications, characterized by
a patterned semiconductor heterostructure surface forming the source, drain and gate contacts to build up hybrid electronic devices from this semiconductor base structure and one or more conductive organic „wires".

2. Semiconductor base structure according to claim 1, characterized in
that the organic „wires" are organic molecules with conjugated π-electron system, DNA oligonucleotides or carbon nanotubes.

3. Semiconductor base structure according to claim 1 or 2, characterized in
that the one or more organic wires of this hybrid system are further functionalized with receptors for biomolecular recognition or receptors made of biomolecules which recognize bioactive molecules like hormones, polysaccharides, lipids, or drugs such that the device can be employed as highly sensitive electrical biosensor for the detection, analysis and quantification of specific biomolecules and their mutual interaction.

4. Semiconductor base structure according to claim 3, characterized in
that the receptors for biomolecular recognition are antibodies or proteins.

5. Semiconductor base structure according to one of the claims 1 to 4,

c h a r a c t e r i z e d b y
a semiconductor heterostructure which consists of a material stack of two thick (typically 50nm - 1µm) undoped layers of material „A" separated by an extremely thin (typically 1nm - 20nm) doped layer of different thin semiconductor material „B" or of different composition in case of compound semiconductors, with conductive source and drain electrodes on top of material „A" which are separated only by a very short, groove-like „nanogap" (Figure 2A).

6. Semiconductor base structure as in claim 5,
c h a r a c t e r i z e d i n
that the thin, selectively etched layer fulfils the function of a field effect gate electrode when operating the hybrid electronic device as a molecular electronics or biosensing device.

7. Semiconductor base structure as in claims 1 to 5,
c h a r a c t a r i z e d i n
that the wires may consist of molecules of length fitting or exceeding the gap and being terminated and chemical endgroups able to covalently bind to the metal electrodes.

8. Semiconductor base structure as in claim 3,
c h a r a c t e r i z e d i n
that a selective binding of a bio-molecular analyte to the organic nanowire changes the receptor's electron affinity towards the wire thus modifying its delocalized electron distribution and in turn leads to a change in molecular conductance.

9. Semiconductor base structure as in one of the claims 5 or 6,
c h a r a c t e r i z e d i n

that the heterostructure material stack comprises undoped AlGaAs for the thick layers and doped GaAs for the thin middle layer.

10. Semiconductor base structure as in one of the claims 5 or 6,
c h a r a c t e r i z e d i n
that the deposited metal is an alloy of Pd and Au.

11. A method of producing a semiconductor base structure according to claim 5,
c h a r a c t e r i z e d i n
that the material stack being cleaved perpendicular to the layer planes and the obtained cleavage plane being subsequently selectively etched such that only the central thin layer „B" is removed (typically 1nm - 50nm) deep into the cleavage plane and a thin (typically 1nm - 20nm) metal layer being deposited on the etched cleavage plane from an angle (Figure 1B) to form the conductive source and drain electrodes.

12. A method for producing a semiconductor base structure according to claim 11,
c h a r a c t e r i z e d i n
that the described cleavage is performed twice along different preferably perpendicular crystal directions and that two metal layers are being deposited sequentially from different angular directions in such way that a region of minimal electrodes distance forms exactly and only at the corner of the two cleavage claims.

13. A method for producing a semiconductor base structure according to claims 11 or 12,
c h a r a c t e r i z e d i n

that semiconductor heterostructure is epitaxially grown by molecular beam epitaxy (MBE).

14. A method for producing a semiconductor base structure of claim 7 according to one of the claims 11 to 13, c h a r a c t e r i z e d i n that wire are being deposited by self-assembly techniques from solution or solid source evaporation in ultra-high vacuum.